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3 WASTESTREAM INFORMATION

3.1 INTRODUCTION / BACKGROUND

The P&U manufacturing facility at Kalamazoo, Michigan (referred to as “Facility” or “Site”) produces pharmaceutical chemicals. Site operations currently include pharmaceutical product development and production of both finished products and intermediates for further pharmaceutical manufacturing to be processed and/or packaged elsewhere

A portion of the plant production wastewaters are currently disposed via deepwell injection into the Eau Claire/Mt. Simon using two deepwells, Well Nos. 3 and 4. These wells were drilled in 1975 and 1980 respectively. Federal permits were issued for both wells September 30, 1985, and the land ban petition for the wells was approved in March of 1990. Injectate has been monitored as required by site operating permits since 1985. Sample data was and is acquired as required by permit, and the summary presented in this document is based on the waste stream analyses that were included in the facility Monthly Waste Sample Reports historically submitted to USEPA and MDEQ (Appendix 3-I).

P&U intends to continue using the existing injection wells for disposal of process water. Water is piped to holding tanks, then diverted to either Well No. 3 or Well No. 4. Figure 3-1 presents a general process flow diagram illustrating the system that delivers process waste water to the injection wells.

3.2 REGULATORY STANDARD

40 *CFR* § 148.22 Underground Injection Control (UIC) regulations require that the following information pertinent to the waste stream be provided in the petition:

(a) “Any petition submitted to the Director pursuant to 40 *CFR* § 148.20(a) shall include the following components:
   (1) An identification of the specific waste or wastes and the specific injection well or wells for which the demonstration will be made;
   (2) A waste analysis to describe fully the chemical and physical properties….”

Additionally, 40 *CFR* § 146.70 (d) states that any permit (and hence permit application) shall include information pertaining to waste minimization:

> "(1) the generator of the hazardous waste has a program to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable…."

The most recent permit issued for the site and the most recent permit renewal documentation provided to US EPA include require information pertaining to waste minimization.

The specific processes from which injectate is derived are discussed in Section 3.3. Representative sampling to derive waste characterization information is also addressed in Sections 3.3.2-3.3.4 where the Waste Analysis Plan (WAP) applicable to future operations is introduced (the full WAP is included in Appendix 3-II). Wastewater analysis is discussed and the appropriate Appendix containing the detailed analytical data is referenced in these sections. The WAP is provided herein for reference only, and is intended to be an enforceable part of the UIC permits and may be modified in the future without requiring modification of the permits or land ban petition approval. Section 3.4 addresses the identification of hazardous waste numbers applicable to injectate. Key parameters evaluated in land ban petition modeling are presented in Section 3.5 (along with CAS numbers), and waste minimization and alternatives to injection are presented in Section 3.6. Waste injection continues to be the most environmentally protective and cost effective method available to manage the injectate.

3.3 DESCRIPTION OF PROPOSED WASTE STREAM

The waste stream that will continue to be generated and disposed in deepwells at the P&U site consists of process waste waters generated at the P&U site and waste associated with well operation, maintenance and testing. A detailed description of the various components of the injection process and proposed process waste streams is provided below.

3.3.1 Process Line Description

Wastewater at the site originates from a large number of pharmaceutical and animal health product manufacturing processes conducted in thirteen production buildings, with each process generating multiple waste streams. Wastewater potentially diverted to the deepwell system may originate from one of three lines: the J Line, SJ-Line, and Z-Line. Each line is described below.

The J-line and SJ-line are the two waste stream lines in the plant that transfer wastewater from three production buildings in the manufacturing facility to the UIC receiving tanks. These waste streams consist of aqueous waste that can't be discharged to the sanitary sewer or the P&U pre-treatment system (Z-line discussed below). They consist of water with residual solvents and metals or an active ingredient that that is considered an aquatic toxin. The J-line carries the metal containing aqueous streams while the SJ-line carries aqueous streams that contain the aquatic toxins.

The Z-line handles wastewater streams that have trace organic contamination and must go through the pre-treatment system before discharge to the Kalamazoo Wastewater Treatment Plant through the sanitary sewer. These streams could be diverted to the UIC tanks if access to the Z-line were not available.

Figure 3-1 presents the process flow from each of the three lines. This figure illustrates the primary injection system surface storage and pre-treatment components that are located in the P&U Chemical Process Wastewater Management (CPWM) area (Figure 3-2):

- Two receiving tanks (ST-312 and ST-319)
- Z-line transfer to the injection well line from tanks (ST-317 or ST-318)
- Solids filtration system
- Capability for pH adjustment

Waste enters the receiving tanks via above ground piping directly from facility production process areas. Figure 3-1 also shows the flow of injected streams to the storage tanks, through the filters and/or pre-treatment equipment, and into the injection wells.

Summary of Process Flow

1. Approved and designated waste streams from production buildings are received in storage tanks (ST) through the J-line, SJ-line or Z-lines.

2. J-line waste in ST-312
   a. Pumped from ST-312
   b. Solids removal using bag filters and/or 5 micron Cuno filters
   c. Injected in Deepwell 3 or 4

3. SJ line-waste in ST-319
   a. Pumped from ST-319
   b. Solids removal using bag filters and/or 5 micron Cuno filters
   c. Injected in Deepwell 3 or 4

4. Z line-waste in TANK5030, TANK5031, and ST-320 (Note: Z-line waste typically is discharged to the local publicly owned treatment works (POTW), but can be designated for injection as outlined below)
   a. Adjusted, if needed, to 2-5 pH with HCl
   b. Pumped from storage tank to stripper column
   c. Solvents removed in overheads of stripper column
   d. Wastewater removed in bottoms of stripper column and collected in Bottoms Tanks ST-309 and ST-310
   e. Solids removed using clarifier or bag filters
   f. Filtered wastewater collected in ST-317 and ST-318, transferred to J-line Solids Filtration
   g. Final solids removal using 5 micron Cuno filters
   h. Injected in Deepwell 3 or 4

Figure 3-2 shows the location of the CPWM area.

3.3.2 Injectate Chemical Characteristics

Table 3-1 presents the summary of injectate chemistry as presented in the 2012 permit reapplication, which was based on data collected from the years 2008 through 2012 at the P&U facility. The table also presents additional data obtained in 2013. Appendix 3-I provides a summary of detailed analytical data obtained as required by the injection well permits for each well. Table 3-2 shows the analytical sampling and testing requirements of each currently approved well permit, and Table 3-3 presents the constituent concentrations presented in the original petition (1989), as well as concentrations identified in subsequent 1997 and 2002 permit reapplication renewals, limits set in the 2003 permit, and maximum concentrations presented in the 2012 permit applications. These data show that the analytical suite has included the same constituents since 1989, although some compounds were added in the 2003 permit. Table 3-3 also shows that the maximum concentrations presented in Table 3-1 effectively bound the concentrations that were identified historically. Multiples of values presented in Table 3-1 were used in containment modeling presented in Section 8 of this petition renewal. Acetone, methanol, tetrahydrofuran, and methyl isobutyl ketone were modeled at values that were equal to or exceeded their respective permit limits. For compounds with no permit limits, the highest concentration of constituents on Table 3-1 were multiplied by 2x for inorganic compounds and 10x for organic compounds, but not more than a factor of $1x10^8$ times applicable health based limits, ensuring extremely conservative modeled parameter assumptions. Note that while fewer compound concentrations were specified in the 1989 No-migration Petition, EPA approved the land ban petition for all current permit hazardous waste numbers except for D022 (Chloroform) D028 (1,2 Dichloroethane), D035 (Methyl Ethyl Ketone), and D038 (Pyradide). These four compounds were later approved by EPA through petition modifications in 1997. Injectate density assumptions used in the 1989 petition and subsequent petition update modeling is consistent with injectate density presented in Chapter 8 of this petition renewal. See Chapter 8 for additional details regarding modeling assumptions.

Table 3-1. Typical Waste Stream Concentrations, January 2008 - 2013

Parameter	Maximum Concentration from the 2012 UIC Permit Reapplications (mg/L)	2013-Identified Maximum Concentration in Monthly Operating Reports, Well No. 4 (mg/L unless otherwise specified)
pH	2 - 7	5.13-6.55 (monthly average)
Flash Point °F	35 - 200	35->200
Butyl Acetate	<500	<500
n-Butanol	<500	<500
n-Propanol	<500	<500
Tert-Butanol	<500	<500
Cyclohexane	<50	<50
Heptane	<50	<50
Methyl Ethyl Ketone	<200	<200
1,2-Dichloroethane	<10	<10
Chloroform	<10	<10
Dimethylformamide	670,000	500,000
Acetone	350,000*	13%, 130,000
Methanol	350,000*	20%, 200,000
Total Organic Carbon	180,000	190,000
Total Dissolved Solids	125,000	111,000
Acetic Acid	85,000	Not reported in MOR
Tetrahydrofuran	50,000*	<0.05%
Methyl Isobutyl Ketone	50,000*	>0.02%
Sodium Bisulfite	42,000	Not reported in MOR
Sulfuric Acid	39,300	Not reported in MOR
2-Butanol	29,100	Not reported in MOR
Methylene Chloride	21,000	69,000
Triethylamine	20,000	17,000
Sodium Hydroxide	14,650	Not reported in MOR
Total Zinc	14,500	9,750
Hydroxylamine Hydrochloride	12,500	Not reported in MOR
Total Halogens	12,000	28,000
Chromium, Total	10,300	11,900
Dimethylsulfoxide	10,000	Not reported in MOR
Pyridine	9,000	<10,000

Parameter	Maximum Concentration from the 2012 UIC Permit Reapplications (mg/L)	2013-Identified Maximum Concentration in Monthly Operating Reports, Well No. 4 (mg/L unless otherwise specified)
Acetonitrile	8,700	<500
Sodium Chloride	7,950	Not reported in MOR
Sodium Bicarbonate	7,950	Not reported in MOR
Manganese	5,890	1,360
Formic Acid	3,600	Not reported in MOR
Methyl t-Butyl Ether	2,900	<50
Total Suspended Solids	1,500	640
Ethanol	1,300	14,000
Isopropanol	1,100	<500
Hexavalent Chromium	1,070	870
Ethyl Acetate	570	600
Toluene	410	32
Hexane	66	<50
o-Xylene	34	<10
Silver	18	Not reported in MOR
Total Cyanide	6	1.99
Lead	1	<50
Formaldehyde	0.4	Not reported in MOR
Copper	0.3	2.8

*based on existing permit limit

Table 3-2. Monitoring Frequencies and Methods

Parameter	Typical Detection Threshold Concentrations mg/L	Analytical Methods (SW-846)	Monitoring Frequency
pH	0.01 pH units	9040C	Daily
Flow	0.01 gal/min	Instrument flow meter reading	Daily
Specific Conductance	0.01 ms/cm	9050A	Daily
Specific Gravity	0.01 g/ml	Instrument flow meter reading	Daily
Temperature	0.01 degrees C	Instrument flow meter reading	Daily
Total Suspended Solids	100	SM 2540 D, EPA 160.2	Monthly
Hexavalent Chromium	0.05	EPA 7196 A	Monthly
Total Chromium	1	EPA 200.7, 6010	Monthly
Total zinc	1	EPA 200.7, 6010	Monthly
Total Lead (low level)	0.5	EPA 200.7, 6010	Monthly
Copper	0.2	EPA 200.7, 6010	Monthly
Manganese	0.05	EPA 200.7, 6010	Monthly
Mercury	0.002	EPA 245.2, 7470A	Monthly
Cyanide	0.2	SM 4500 CN, C E, 9010C/9014	Monthly
Total Dissolved Solids	100	SM 2540 C, EPA 160.1	Monthly
Total Organic Carbon	100	SM 5310 C, 9060	Monthly
Flash Point	30 – 200	EPA 1010	Monthly
Total Halogens	NA	Parr 207 M, 5050/9056	Monthly
Acetone	100	EPA 8260	Monthly
Acetonitrile	500	EPA 8260	Monthly
Butyl Acetate	500	EPA 8260	Monthly
Chloroform	10	EPA 8260	Monthly
Cyclohexane	50	EPA 8260	Monthly
Cyclohexanol	500	EPA 8260	Monthly
Dimethylformamide	100	EPA 8015	Monthly
Ethanol	50	EPA 8015	Monthly

Parameter	Typical Detection Threshold Concentrations mg/L	Analytical Methods (SW-846)	Monitoring Frequency
Ethyl Acetate	500	EPA 8260	Monthly
Heptane	50	EPA 8260	Monthly
Hexane	50	EPA 8260	Monthly
Isopropanol	500	EPA 8260	Monthly
Isopropyl Acetate	500	EPA 8260	Monthly
Methanol	50	EPA 8015	Monthly
Methyl Ethyl Ketone	200	EPA 8260	Monthly
Methyl Isobutyl Ketone	200	EPA 8260	Monthly
Methyl-T-Butyl Ether	50	EPA 8260	Monthly
Methylene Chloride	10	EPA 8260	Monthly
n-Butanol	500	EPA 8260	Monthly
n-Propanol	500	EPA 8260	Monthly
Pyridine	100	EPA 8015	Monthly
Tert-Butanol	500	EPA 8260	Monthly
Tetrahydrofuran (THF)	500	EPA 8260	Monthly
Toluene	10	EPA 8260	Monthly
Triethylamine	1000	EPA 8015	Monthly
Xylene	10	EPA 8260	Monthly
I ,2-Dichloroethane	10	EPA 8260	Monthly

Table 3.3. Injectate Concentrations as Presented in Petitions and Permit Applications, P&U Facility

Parameter	2012 Permit Re-Application	2003 Permit		2002 Permit Re-Application Table H-3		1997 Permit Re-Application Table 1		1989 Petition[4]	
	Maximum Concentration (mg/L)	Concentration (mg/l)	Permit Concentration Limits	Concentration (mg/l)		Concentration (mg/l)		Concentration (Volume % unless otherwise indicated)	
				Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
pH	2 - 7[1,3]	--	--	2.2[1]	5[1]	2.2[1]	5[1]	3[1]	4.5[1]
Flash Point °F	35 - 200[2]	50[4]	--	50[2]	200[2]	50[2]	200[3]	--	--
Butyl Acetate	<500	<500	--	--	<100	--	<100	--	--
n-Butanol	<500	<500	--	--	<250	--	<250		
n-Propanol	<500	<500	--	--	<250	--	<250	0	0.1
Tert-Butanol	<500	<500	--	--	<500	--	<500	0.1	0.3
Cyclohexane	<50	<50	--	--	--	--	<10	--	--
Heptane	<50	<50	--	--	<5	--	<5	0	0.1
Methyl Ethyl Ketone	<200	<200	--	--	<1	0.002	20	0	0.2
1,2-Dichloroethane	<10	<10	--	--	<2	--	<2	--	--
Chloroform	<10	<10	--	--	<1	--	<1	--	--
Dimethylformamide	670,000	2,200	--	1,000	8,000	1,000	8,000	0	0.3
Acetone	350,000[3]	8.9	35% Maximum	1,000	350,000[3]	1,000	350,000[3]	0.2	0.8
Methanol	350,000[3]	0.037	35% Maximum	1,000	350,000[3]	1,000	350,000[3]	1	3
Total Organic Carbon	180,000	130,000		10,000	130,000	10,000	70,000	--	--
Total Dissolved Solids	125,000	20,200		10,000	125,000	10,000	50,000	--	--
Acetic Acid	85,000	--	--	--	--	--	--	--	--
Tetrahydrofuran	50,000[3]	0.05	5% Maximum	1,000	50,000[3]	1,000	50,000[3]	0	0.4
Methyl Isobutyl Ketone	50,000[3]	0.02	5% Maximum	1,000	50,000[3]	1,000	50,000[3]	0	0.1
Sodium Bisulfite	42,000	--	--	--	--	--	--	--	--
Sulfuric Acid	39,300	--	--	--	--	--	--	--	--
2-Butanol	29,100	--	--	--	--	--	--	--	--
Methylene Chloride	21,000	230	--	--	<19,000	--	<1,000	0	0.3
Triethylamine	20,000	<100	--	1	5,000	1	5,000	0	0.1
Sodium Hydroxide	14,650	--	--	--	--	--	--	--	--

Parameter	2012 Permit Re-Application	2003 Permit		2002 Permit Re-Application Table H-3		1997 Permit Re-Application Table 1		1989 Petition[4]	
	Maximum Concentration (mg/L)	Concentration (mg/l)	Permit Concentration Limits	Concentration (mg/l)		Concentration (mg/l)		Concentration (Volume % unless otherwise indicated)	
				Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Total Zinc	14,500	555	--	5	6,000	5	6,000	400 ppm	1,200 ppm
Hydroxylamine Hydrochloride	12,500	--	--	--	--	--	--	--	--
Total Halogens	12,000	1	--	1	1.5	1	1.5	--	--
Chromium, Total	10,300	504	--	5	16,100	5	6,000	100 ppm	500 ppm
Dimethylsulfoxide	10,000	--	--	--	--	--	--	--	--
Pyridine	9,000	<0.5	--	0.10	20	0.10	20	0	0.1
Acetonitrile	8,700	<500	--	--	<100	--	<100	0	0.05
Sodium Chloride	7,950	--	--	--	--	--	--	--	--
Sodium Bicarbonate	7,950	--	--	--	--	--	--	--	--
Manganese	5,890	<0.5	--	1	11,900	1	100	--	--
Formic Acid	3,600	--	--	--	--			--	--
Methyl t-Butyl Ether	2,900	<50	--	--	<100,000		<100	--	--
Total Suspended Solids	1,500	14	--	50	200	50	200	300 ppm	1500 ppm
Ethanol	1,300	<5	--	1,000	4,000	1,000	4,000	0	0.2
Isopropanol	1,100	<0.5	--	--	--	--	--	0	0.1
Hexavalent Chromium	1,070	<10	--	--	<54	--	<10	--	--
Ethyl Acetate	570	<500	--	--	<50,000	--	<50,000	0	0.3
Toluene	410	<10	--	1	30	1	30	0	0.1
Hexane	66	<50	--	--	<5	--	<5	0	0.05
o-Xylene	34	<10	--	--	<5	--	<5	0	0.1
Silver	18	--	--	--	--	--	--		
Total Cyanide	6	<0.2	--	--	<1	--	<1	--	--
Lead	1	<5	--	--	--	--	--	--	--
Formaldehyde	0.4	--	--	--	--	--	--	--	--
Copper	0.3	<1	--	1	5	1	5	10 ppm	100 ppm
Mercury, Total (mg/l)	--	<0.002	--	--	--	--	--		
	--		--	--	--	--	--		

Parameter	2012 Permit Re-Application	2003 Permit		2002 Permit Re-Application Table H-3		1997 Permit Re-Application Table 1		1989 Petition[4]	
	Maximum Concentration (mg/L)	Concentration (mg/l)	Permit Concentration Limits	Concentration (mg/l)		Concentration (mg/l)		Concentration (Volume % unless otherwise indicated)	
				Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Cyclohexanol (mg/l)	--	<500	--	--	<100	--	<100		
Isopropyl Acetate (mg/l)	--	<500	--	--	--	--	--		

1 pH units
2 ºF units
3 Calculated based on permit concentration limit.
4 Volume % unless otherwise noted. The original petition indicated that various other chemicals may be present in the waste, but did not identify the parameters. Compounds identified by "—" in 1989 Petition column are among those potentially present in original injectate.
--- in other columns indicates the compounds was not reported or listed in the associated document

3.3.3 Waste Stream Volume

The maximum total permitted combined monthly injection rate into Well Nos. 3 and 4 is 2.5 million gallons. The original 1990 EPA Land Ban approval limited injection to 20 million gallons per year, but this was increased to 30 million gallons per year in 1997, as approved by EPA. No set procedure regarding apportionment of waste volumes to Well Nos. 3 and 4 is proposed. Based on past operating practice, it is expected that the maximum instantaneous injection rate at each well is not likely to exceed 57 gpm, and the maximum injection volume in each well is not expected to exceed 82,136 gpd, although these values may fluctuate so long as monthly permit limits are not exceeded. Since 1977, a total of approximately 325,619,000 gallons of waste has been disposed via Well Nos. 3 and 4. The injection volume has decreased substantially over time; approximately 308 million gallons were disposed over the 22-year period from 1976-1998, but only approximately 14.4 million gallons were injected between 1998 and 2012 (Figure 3-3). For the purposes of this containment demonstration, the incremental future injection into Well Nos. 3 and 4 is projected to be approximately 750 million gallons. If this volume was injected at the recent total site average of less than 2 million gallons per year would be reached in 375 years. For the purposes of evaluating waste containment, this maximum rate has been modeled using an operational lifetime projection of 25 years, from January 1, 2014 to January 1, 2039. It is also noted that although the individual well rate is not likely to be exceeded, this containment demonstration is projected to be valid for any rate distribution between the wells for a cumulative rate of up to 30 million gallons per year for the combined two-well system. Flow rates for each well will continue to be measured using dedicated flow meters at each of the wells.

3.3.4 Proposed Waste Stream Sampling and Analysis

Appendix 3-II presents a copy of the Waste Analysis Plan (WAP) that was included in the 2012 permit application renewal request that will apply to future well operations. This plan may be altered in the future as needed to address changing operational requirements. The analyte list is intended to satisfy regulatory requirements and specifications to be listed in the applicable UIC permits. Sampling requirements are assumed to be a UIC permit condition, and no specific land ban petition approval is requested regarding sampling compliance activities.

Future injectate composition is expected to be consistent with maximum concentrations presented in Table 3-1. Appendix 3-I includes specific gravity information and shows that the typical injectate specific gravity over the period of 2006-2012 was approximately 1.0, with an occasional outlier as low as 0.874 (23.1^{o} C) to over 1.275 (23.7 ^{o} C). Monthly average specific gravity for projected injectate is expected to be approximately 0.99 to 1.01 based on characteristics of the injectate over the past 10 years and this is not projected to change substantially in the future. Based on this range, a conservative specific gravity range of 0.90-1.1 was used in modeling. Additional details regarding the assignment of input parameters for the demonstration of containment are presented in Chapter 8.

Injectate chemistry, including temperature, pH, flow, specific conductance, and specific gravity will be monitored and reported as required in the operating permit. Refer to Appendix 3-I for information pertaining to sample collection methodologies and additional WAP details.

P&U representatives or qualified contract personnel will collect the necessary waste stream samples. Sampling procedures will be conducted at the direction of P&U and the certified or accredited analytical laboratory and in accordance with the minimum standard USEPA procedures. Parameter measurements will be obtained and/or waste samples collected from the sample tap located after the final filtration and prior to the wellhead(s).

3.4 HAZARDOUS WASTE NUMBERS ASSIGNED TO INJECTATE

The land ban petition allows injection of hazardous waste. The following hazardous wastes are by permit and are authorized for injection. Constituents presented in Table 3-1 that are associated with a hazardous waste number are:

F001 Methylene Chloride
F002 Methylene Chloride
F003 Xylene, Acetone, Ethyl Acetate, Methyl Isobutyl Ketone, N-butyl Alcohol and Methanol
F005 Toluene, Methyl Ethyl Ketone, Isobutanol and Pyridine
D001 Ignitability (not on Table 3-1, but include for consistency)

D007	Chromium
D022	Chloroform
D028	1,2-Dichloroethane,
D035	Methyl Ethyl Ketone
D038	Pyridine

3.5 KEY CONSTITUENTS EVALUATED IN MODELING

The key constituents described in this section were used as part of the technical basis for the evaluation of waste containment within the designated Injection Zone. In addition to those chemical constituents explicitly associated with hazardous waste numbers (and described in prior sections), additional chemical compounds were evaluated as part of the containment demonstration to ensure adequate demonstration of the no-migration standard.

Table 3-4 presents a listing of all constituents that have been included in the demonstration of containment presented in Chapters 8 and 9. To ensure completeness, all constituents identified in the most recent permit application as well as those evaluated in past permit applications and the approved no-migration petition have been included. Some of the compounds modeled to ensure historical consistency do not require assignment of an associated listed hazardous waste number based on process knowledge, or assignment of a characteristic hazardous waste number, based on the low concentration of the compound in the injectate.

P&U included this full listing of constituents in modeling efforts to ensure that a comprehensive suite of possible compounds was considered regardless of current regulatory status. The list includes compounds previously included in all previous permit and petition submittals, thus ensuring that the modeling encompasses all possible compounds that might be present in the subsurface during the projected operational lifetime of the wells.

Table 3-4. Injectate Constituents Applicable to 2014 Petition Renewal Modeling*

Constituent/Compound Name	CAS Number	Molecular Weight (g/mole)	Density/Sp Gr (app. 16-20^{0}C, g/cc)
Acetone	67-64-1	58.08	0.79
Acetonitrile (Methyl Cyanide)	75-05-8	41.05	0.7857
n-Butyl alcohol (n-Butanol)	71-36-3	74.12	0.81
T-Butanol (2-Methyl-2-Propanol)	76-65-0	74.12	0.788
Chloroform (Trichloromethane)	67-66-3	119.38	1.48
Chromium, Total (1:6 ratio Cr VI : Cr III)	7440-47-3	52	7.15
Cyanides (soluble CN salts), not otherwise specified, total HCN	74-90-8	27.03	0.6876
Cyclohexane	110-82-7	84.16	0.7739
Cyclohexanol	108-93-0	100.158	0.9624
1,2 -Dichloroethane (Ethylene Dichloride)	107-06-2	98.96	1.245
Dimethylformamide (N,N-Dimethylformamide)	68-12-2	73.1	0.9445
Ethanol (Ethyl Alcohol)	64-17-5	46.07	0.789
Ethyl Acetate	141-78-6	88.11	0.9
Formaldehyde	50-00-0	30.03	0.815
Heptane	142-82-5	100.20	0.6795
N-Hexane (Hexane)	110-54-3	86.17	0.66
Isopropanol (Isopropyl Alcohol, 2-Propanol)	67-63-0	60.1	0.78
Lead	7439-92-1	207.2	11.3
Mercury	7439-97-6	200.59	13.5336
Methanol (Methyl Alcohol)	67-56-1	32.04	0.7914
Methyl Ethyl Ketone (2-Butanone)	78-93-3	72.11	0.8
4-Methyl-2-Pentanone (MIBK, Methyl Isobutyl Ketone)	108-10-1	100.16	0.797
Methyl t-Butyl Ether	1634-04-4	88.15	0.7353
Methylene Chloride (Dichloromethane)	75-09-2	84.93	1.3266
N-Propanol	71-23-8	60.1	0.8035
Pyridine	110-86-1	79.1	0.9819
Silver	7440-22-4	107.87	10.5
Tetrahydrofuran	109-99-9	72.11	0.888
Toluene	108-88-3	92.14	0.8623
Triethylamine	121-44-8	101.19	0.7275
o-Xylene	1330-20-7	106.16	0.87
Zinc (Metallic)	7440-66-6	65.4	7.134
pH	N/A	N/A	N/A
Flashpoint	N/A	N/A	N/A
Total Organic Carbon	N/A	N/A	N/A
Total Dissolved Solids	N/A	N/A	N/A
Acetic Acid	64-19-7	60.05	1.049
Isopropyl Acetate	108-21-4	102.13	0.87

Constituent/Compound Name	CAS Number	Molecular Weight (g/mole)	Density/Sp Gr (app. 16-20^{0}C, g/cc)
Sodium Bisulfite	7631-90-5	104.07	1.48
Sulfuric Acid	7664-93-9	98.07	1.8302
2-Butanol	78-9-22	74.12	0.802
Sodium Hydroxide	1310-73-2	40	2.1
Hydroxylamine Hydrochloride	5470-11-1	69.49	1.67
Total Halogens	N/A	N/A	N/A
Dimethylsulfoxide	67-68-5	78.13	1.100
Sodium Chloride	7647-14-5	58.44	2.165
Manganese	7439-96-5	54.94	7.3
Formic Acid	64-18-6	46.03	1.22
Total Suspended Solids	N/A	N/A	N/A
Hexavalent Chromium	18540-29-9	Compound dependent	Compound dependent

*Compounds included if contained in 1989 petition demonstration or 1996, 2002, 2003 or 2012 permit/permit applications.

3.6 WASTE MINIMIZATION AND ALTERNATIVES TO INJECTION

Disposal of waste water by injection into Well Nos. 3 and 4 is currently the most environmentally sound method of management. As previously documented by the USEPA, deepwell disposal of dilute aqueous waste streams is an environmentally sound liquid waste management method when wells are sited and operated according to regulatory requirements so that the waste is isolated in the subsurface and has no potential for future contact with the accessible environment.

P&U waste waters have been safely managed by deepwell injection for over 37 years. As indicated in Section 3.3.3 and shown in Figure 3-3, annual waste injection volume has decreased significantly since initiation of injection. As part of process record reviews, P&U waste professionals review all new process records or process record changes and must approve any waste stream before it can be sent to the UIC waste lines (J-line and SJ-line). As part of this review process, Pfizer looks to use the UIC wells only as a last option, when discharge to the sanitary sewer or pre-treatment system are not suitable for an aqueous waste stream. As can be seen from the annual waste injection trend, a significant volume of UIC waste was diverted to the sanitary sewer when the pretreatment system was brought online.

Wastewater treatment methods require additional handling of the waste, which can increase the chances for release to the environment or reaction of the wastes. The current wastewaters, as shown in Table 3-1, can be highly concentrated, so the transport and disposal of waste poses logistic and potential health and safety issues. That is, the implementation of additional treatment methods with respect to P&U waste could result in a residual waste that is concentrated to such an extent that management in a landfill or other treatment, storage or disposal facility would be required, mandating transport of the concentrated material. Further, treatment methods require the use of incremental energy and/or chemicals that have associated environmental footprints and risks that may offset any gains associated with reduced injection. In fact, EPA 816-R-01-007 entitled "Class I Underground Injection Control Program: Study of the Risks Associated with Class I Underground Injection Wells" provided a summary of the relatively low risk associated with the use of disposal wells. The report concluded that under current regulatory oversight the use of deepwell injection results in an extremely low risk management option for disposal of wastewater.